Horizontal evaluation method for the implementation of the Construction Products Directive – emissions from construction products into indoor air

Marc Lor[1,*], Kevin Vause[1] , Karla Dinne[1] , Eddy Goelen[2] , Frederick Maes[2] , Anne-Claude Romain[3] , Jacques Nicolas[3] and Christophe Degrave[3]

[1]Belgian Building Research Institute (BBRI), Belgium
[2]Flemish Institute for Technological Research (VITO), Belgium
[3]University of Liège (ULg) – Department "Environmental Sciences and Management", Belgium

[*]*Corresponding email: marc.lor@bbri.be*

SUMMARY
Worldwide different (mostly voluntary) approaches exist to evaluate emissions from construction products. The importance of the relation between construction products and health & environment is highlighted in the mandatory European Construction Products Directive (CPD). One of the objectives of the European Construction Products Directive (CPD) is to harmonize the technical specifications with regard to dangerous substances and construction materials as stated in the Essential Requirement N°3 "Hygiene, health and the environment" (ER3). The Belgian Building Research Institute (BBRI) is involved in the implementation of ER3 by participation in standardisation work on CEN (CEN/TC 351) and EOTA (EOTA PT9) level. This paper presents first results of ongoing BBRI research activities in collaboration with VITO (Flemish Institute for Technological Research) and ULg (Université de Liège) concerning "horizontal evaluation method for implementation of the CPD (HEMICPD)": http://www.bbri.be/go/hemicpd.

KEYWORDS
Building materials, VOC, CPD

INTRODUCTION
The perception about the close relationship between indoor air quality and human health resulted in more and more concern among all stakeholders about healthy buildings and also healthy construction products. Standardisation work on test methods for dangerous substances in the field of construction products is currently ongoing at European level in CEN/TC 351 and EOTA PT9.
The main goal of the HEMICPD research project coordinated by BBRI is to improve the flow of knowledge and information vis-à-vis normalisation activities in the domain of indoor air measurements, indoor product emission testing, labelling and certification by proposing an evaluation method and standardised assessment methods for a harmonised approach relating to emissions from building materials into indoor air for implementation in Belgium. This approach will comply with current harmonisation efforts ongoing on European level. For the purpose of harmonisation different types of evaluation protocols (prEN 15052, AgBB, AFSSET ect) were examined.
Mandate M/366 issued by CEN in April 2005 mentions the use/development of simplified measurement/test methods of emission. In this context µ-chamber experiments were undertaken and comparison was made with test chambers of various sizes.
The (V)(S)VOC research part is situated in the framework of the CPD. The other three research topics of the HEMICPD project are particle emissions from building materials,

methods for evaluating the microbial resistance and characterization of odour emissions of building materials. The latter ones are situated in the field of prenormative research.

METHODS

Emission tests are performed on different construction product families by means of test chambers of different sizes: direct desorption, the so called µ-chamber , $1m^3$ & $50\ m^3$ test chambers and FLEC. (S)VOCs are extracted by thermal desorption, analyzed with gas chromatography and identification of the compounds is done by mass spectrometry. Formaldehyde and short chain aldehydes (VVOC) are analyzed by means of HPLC coupled with UV detection. Multivariate analysis (principal component analysis – PCA) is performed on the different data sets to reveal similarities and/or differences in test methods.

RESULTS

Different building materials (flooring materials, insulation materials, paints ect) were investigated with different test methods. Results of the chemical analysis of a linoleum floorcovering with the µ-chamber technique (see figure 1) after 7 days are shown in figure 2.

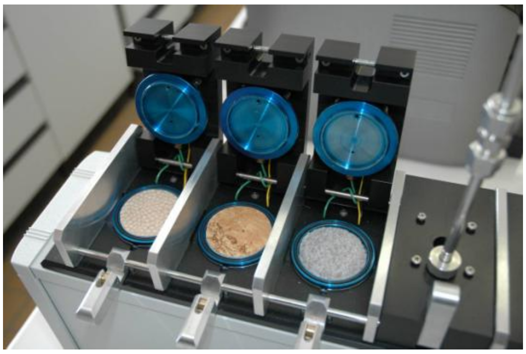

Figure 1: Emission testing of different floorcoverings with the µ-chamber technique.

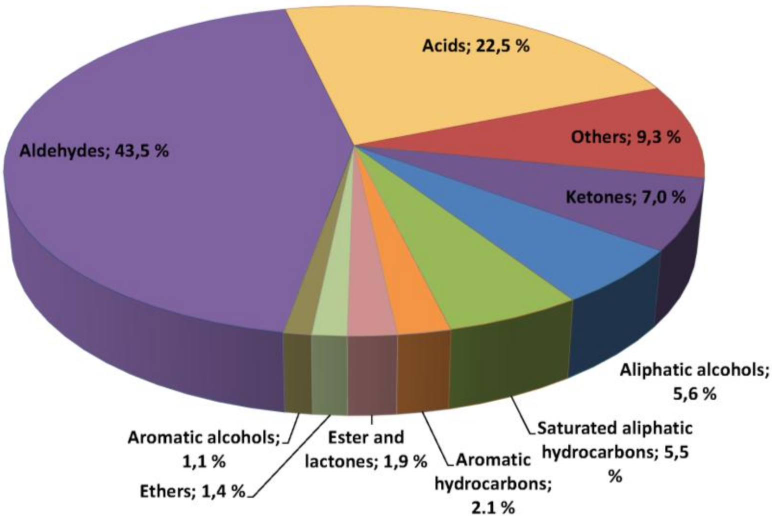

Figure 2: Pie chart of the emission results of a linoleum measured after 7 days with µ-test chamber.

As shown in the pie chart (figure 2) the chemical families of aldehydes and acids are the main contributors to the linoleum emission profile.

The results (emission characteristics) obtained for several material groups and different test methods were compared. An example of such a comparison is shown in figure 3 for a linoleum floor covering measured after 7 days. An overview of the parameters of the different test methods is shown in table 1.

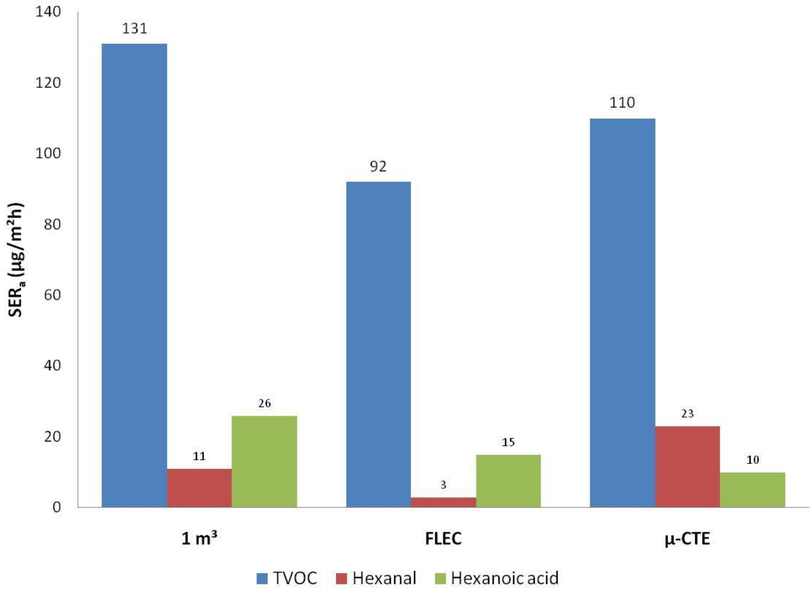

Figure 3: Comparison of emission results (SER_a) obtained with different test methods after 7 days for a linoleum floor covering.

Table 1: Overview of the parameters of the different test chambers.

Parameters	µ-CTE	FLEC	1m³
Sample Diameter (m)	4,5E-02	1,5E-01	
Exposed area (m²)	1,3E-03	1,8E-02	4,0E-01
Chamber volume (m³)	3,2E-06	3,5E-05	1,0E+00
Load factor (m²/m³)	4,1E+02	5,1E+02	4,0E-01
Exchange rate (h^{-1})	4,9E+02	5,1E+02	5,0E-01
Air flow rate (L/min)	0,03	0,3	8,3
Chamber temperature (°C)	23	23	23
Area specific air flow rate (m³/m².h)	1,2	1,0	1,2

DISCUSSION

In order to highlight the influence of the test methods and in particular of the various chambers a statistical analysis (PCA) has been performed on the data of the different flooring samples.

We observe that the use of chemical families to classify the samples gives good results. Sample 2 (PVC flooring material) is well separated from sample 4 (linoleum). There is no discrimination inside the cluster of sample 2 (PVC) due to the chambers, for sample 4 (linoleum) a separation of the data is observed. The addition of the chemical families on the PCA plane gives information on the separation. In the two dimensional space of the PCA, differences between samples are much more pronounced than the differences observed between chambers. These small differences between chambers could be explained by two factors: age of the materials and experimental procedures.

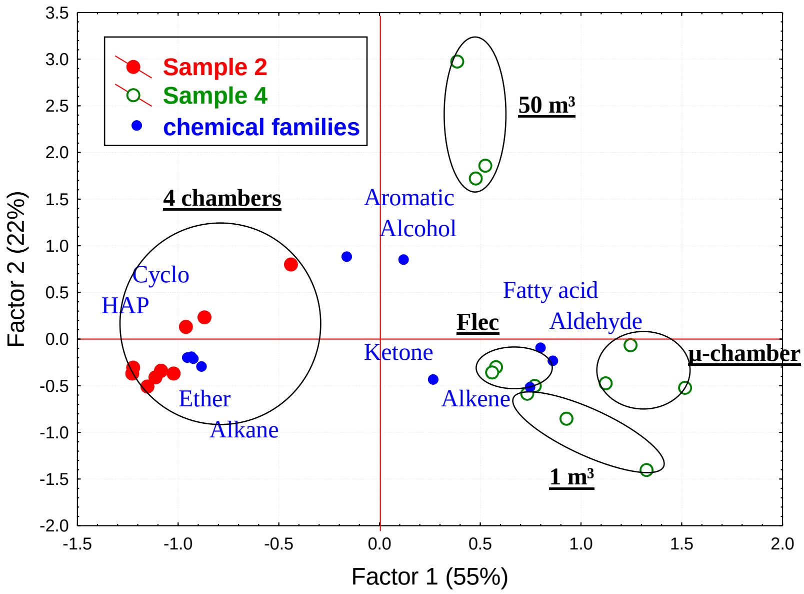

Figure 4: PCA results (chemical families – loadings – and data –scores – on the same plot): comparison of two floor covering samples (sample 2= PVC; sample 4= linoleum) for different test methods ($50m^3$, $1m^3$ chamber, FLEC and μ-chamber).

CONCLUSIONS

Construction products may only be placed on the market in the European Union if they accord with the harmonised technical specifications and bear the CE mark. This requires that consideration is given to hygiene, health and environmental protection. Manufacturers and authorities need transparent schemes to assess the performance of the product. The ongoing (Belgian) research activities support these developments.

ACKNOWLEDGEMENT

These research activities are supported by the Belgian Science Policy (Belspo) and the FPS Economy, SMEs, self-employed and Energy.

REFERENCES

Goelen, E., Maes, F. and Lor, M. February 2009. The HEMICPD project – comparing emission test protocols. *BUMA final workshop Building Materials and Indoor Air Quality*, Brussels: http://www.enman.uowm.gr/bumaproject/

Lor. M. March 2008. Comments on Draft CEN/TC 351 TR2 Report - Part 2: Indoor Air. *CEN/TC 351 TG2 workshop*, Berlin: http://www.centc351.org

Lor M., Vause K., Goelen E. et al, August 2008 .Implementation of health aspects (ER N°3) in the Construction Products Directive (CPD) regarding emissions to indoor air. In *Proceedings of the 11th International Conference of Indoor Air Quality and Climate – Indoor Air 2008*, Copenhagen, pp 71.

Lor M., Vause K., Goelen E. et al, October 2008. How to evaluate the impact of building materials on health & indoor environment? *International Certech Conference Emissions and Odours from Materials*, Brussels.

Lor, M. and Winnepenninckx E. 2008. Draft ER3 checklist for ETAG 21 - Cold storage rooms and cold storage envelope and building kits, *edition 06/11/2008*: http://www.eota.be/

Lor M; and Vause K. Matériaux de construction et santé. *CSTC dossier, N°2/2008, cahier N°1, pp 1-4.*

Romain, A.-C., Delva, J. and Nicolas, J.. 2008. Complementary approaches to measure environmental odours emitted by landfill areas. *Sensors and Actuators B: Chemical*, 131, 1, 18-23.